

# **WBS 1.7 Vacuum Systems**

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# WBS 1.7 Vacuum Systems

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## SCOPE OF WORK

### WBS 1.7.1 Beam Pipes and Chambers

Design, fabrication, procurement, assembly and vacuum processing of chambers/beam pipes and vacuum fittings/components. Design and procurement of heating blankets.

### WBS 1.7.2 Instrumentation & Controls (I&C)

Design, fabrication, procurement, assembly and testing of a PLC based controls system which monitors and controls pumps, gauges and valves and provide vacuum interlocks.

### WBS 1.7.3 Pumps

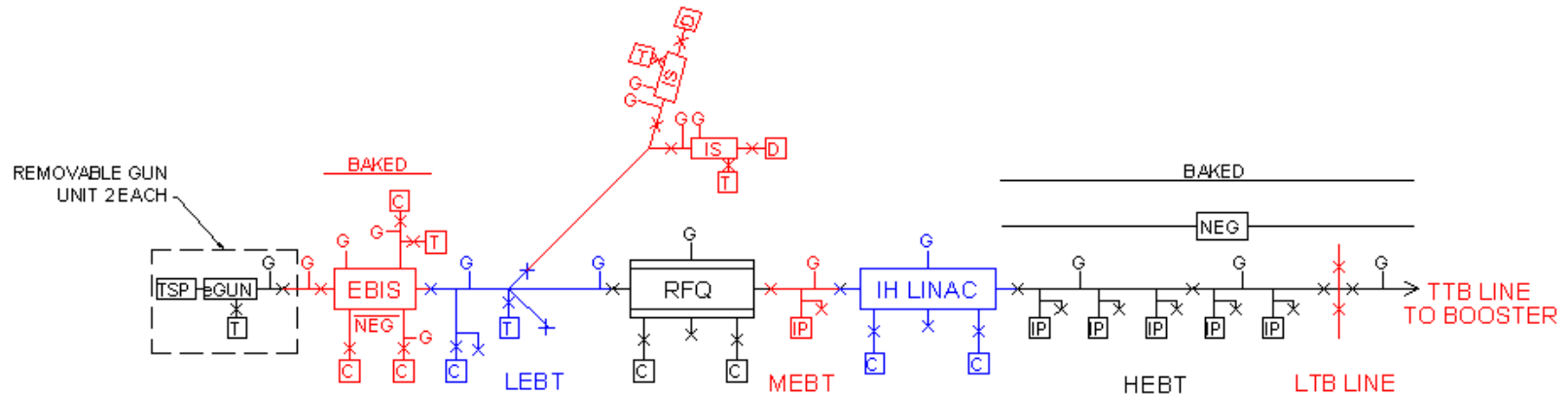
Design, specification, procurement, assembly and testing of Cryo, Diffusion, Ion, NEG, Titanium and Turbo molecular vacuum pumps.

### WBS 1.7.4 Valves

Design, specification, procurement, assembly and testing of vacuum valves.

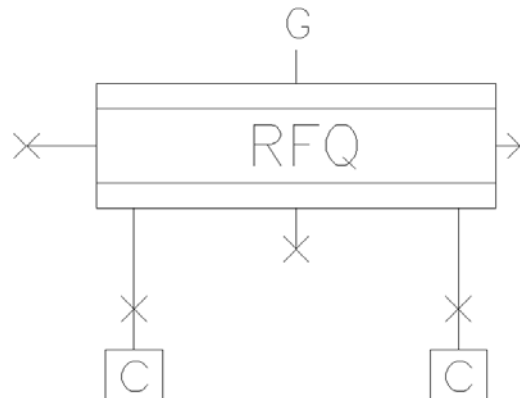
# WBS 1.7 Vacuum Systems

## VACUUM SYSTEM SCHEMATIC



## VACUUM DEVICE LEGEND

- (X) - VALVE
- (G) - CCG/PIRANI GAUGE
- [C] - CRYO PUMP
- [IP] - ION PUMP
- [T] - TURBO PUMPING STATION
- [TSP] - TITANIUM SUBLIMATION PUMP
- [NEG] - NON-EVAPORABLE GETTER PUMP
- [D] - DIFFUSION PUMP



## TYPICAL SECTOR

- GAUGES- ATM.- $10^{-11}$  TORR
- PUMPS- CRYO, NEG....
- GATE VALVES-
- SECTOR/PUMP ISOLATION

# WBS 1.7 Vacuum Systems

## Vacuum Requirements

- **EBIS** -  $10^{-10}$  Torr, in situ baked  $250^{\circ}\text{C}$
- **LEBT, RFQ, MEBT & IH LINAC** - Vacuum levels of  $10^{-8}$  and  $10^{-9}$  Torr are sufficiently low for the partially stripped low energy ion beams for all these regions due to the single pass nature.
- **HEBT** - Vacuum of  $10^{-10}$  Torr is needed in the last section of HEBT to minimize the diffusion of residual gas into the  $10^{-11}$  to  $10^{-12}$  Torr Booster ultrahigh vacuum system. In situ baked  $150^{\circ}\text{C}$

## Vacuum Design Parameters

- Only UHV compatible materials used – stainless steel and ceramics
- No organic materials allowed
- Stainless steel chambers, Inconel bellows
- Conflat flanges- high reliability – low cost
- All components/chambers cleaned and vacuum fired to UHV standards

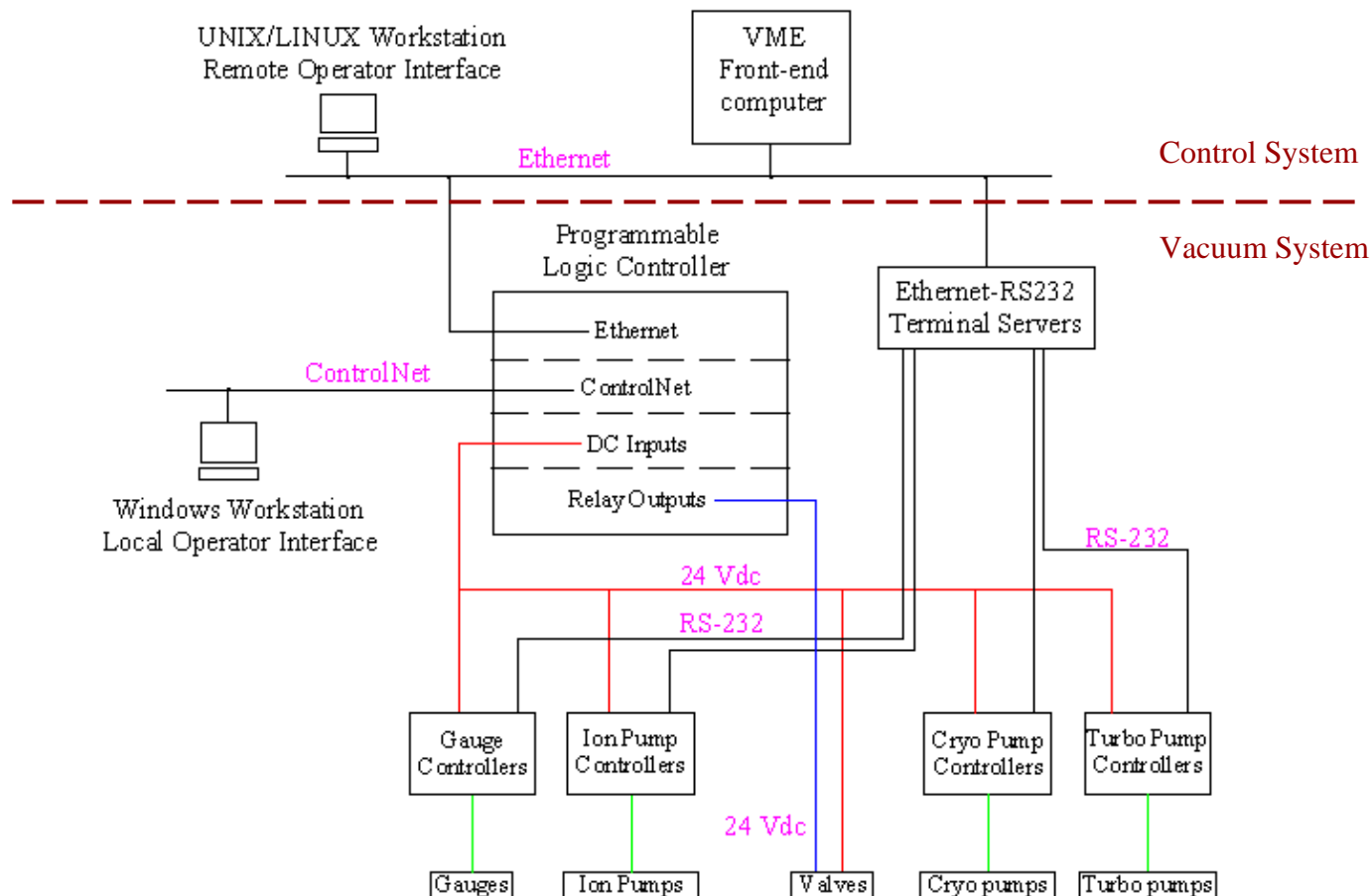
# WBS 1.7 Vacuum Systems

## VACUUM SYSTEMS SUMMARY TABLE

<u>SYSTEM</u>	<u>PUMPS</u>	<u>VALVES</u>	<u>GAUGES</u>	<u>PRESSURE</u>	<u>BAKED</u>
<b>EBIS</b>	3 CRYO, NEG 2 TSP, 3 TURBO	7-10"CF, 1-6"CF 1-8"CF	5 CCG 5 PIRANI	10 <sup>-10</sup> Torr	250° C
<b>IS</b>	2 DIFFUSION 2 TURBO	2-10"CF, 4-6"CF	4 CCG 4 PIRANI	10 <sup>-8</sup> - 10 <sup>-9</sup> Torr	No
<b>LEBT</b>	1 CRYO 1 TURBO	3-8"CF, 2-10"CF 1-6"CF	2 CCG 2 PIRANI	10 <sup>-8</sup> - 10 <sup>-9</sup> Torr	No
<b>RFQ</b>	2 CRYO	2-10"CF, 1-6"CF	1 CCG 1 PIRANI	10 <sup>-8</sup> - 10 <sup>-9</sup> Torr	No
<b>MEBT</b>	1 ION PUMP	1-6"CF	1 CCG 1 PIRANI	10 <sup>-8</sup> - 10 <sup>-9</sup> Torr	No
<b>LINAC</b>	2 CRYO	2-10"CF, 1-6"CF	1 CCG 1 PIRANI	10 <sup>-8</sup> - 10 <sup>-9</sup> Torr	No
<b>HEBT</b>	5 ION PUMPS NEG	7-6"CF	3 CCG 3 PIRANI	10 <sup>-10</sup> Torr	150° C

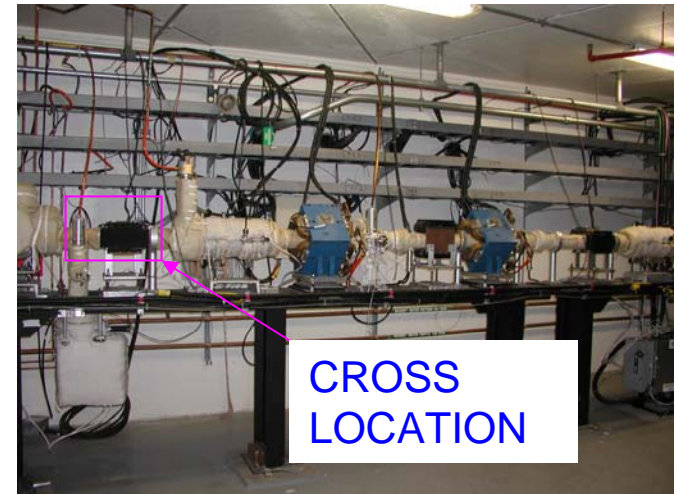
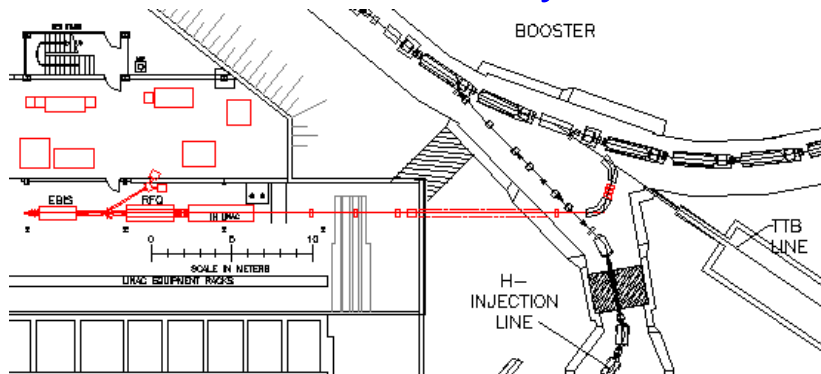
# WBS 1.7 Vacuum Systems

## INSTRUMENTATION & CONTROL SCHEMATIC



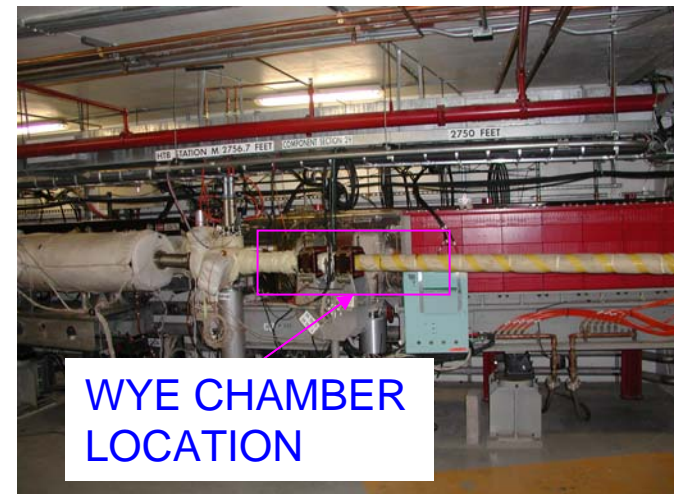
# WBS 1.7 Vacuum Systems

## EBIS Beam line layout



## EBIS HEBT VACUUM SECTOR

- CROSSES LTB LINE
- CONNECTS TO TTB LINE
- MODIFICATIONS TO BOTH LINES



# WBS 1.7 Vacuum Systems

- **Historical Cost** used throughout vacuum systems estimate since it is very similar to other vacuum systems recently installed or upgraded.
- **Standardization** to Existing Vacuum Systems In C-AD Complex
  - Inverted magnetron CCG and controllers (RHIC)
  - 20 l/s sputter ion pumps (Booster) and controllers (RHIC)
  - NEG cartridge pumps and NEG strip (Booster, NSRL)
  - Turbopump stations with dry backing pumps (RHIC)
  - PLC based vacuum monitoring and control (Booster, AGS, RHIC, NSRL)
  - PLC based bakeout system monitors and controls baked section (RHIC, Booster, NSRL)
  - Gate valves and roughing valves (Booster, RHIC, NSRL)
- Use commercially available vacuum fittings, flanges, seals, etc. wherever possible and avoid custom fabrications.



# WBS 1.7 Vacuum Systems

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## Major procurements (in FY05 direct dollars):

- Cryopumps with compressors – \$112K
- Turbopumps - \$144K
- Gate Valves (10", 8" and 6") - \$104K

## Technical Risk Factor:

- **LOW RISK** – Since designs are based on proven existing vacuum systems designs in C-AD complex

# WBS 1.7 Vacuum Systems

- Estimated Cost

WBS	Description	Direct FY'05\$			
		Mat'l	Labor	Contingency	Total
1.7	Vacuum Systems	760	305	\$215 (20%)	1280

- Labor hours/equivalents

Resource Category	estimated hours
Scientist	150
Engineer	1,750
Designer	1,200
Technician	1,500
Building Trades	250
Total	4,850
Full Time Equivalents	2.8